Production Readiness Review – Charge
Quadrupole Cold Mass – MQXB

Background:

The US LHC Accelerator Project is responsible for providing CERN with integrated inner triplet magnet systems for the four interactions regions at points 1, 2, 5, and 8. Each inner triplet consists of four quadrupole magnets, half of which (Q2a and Q2b) are designed and built by Fermilab and half (Q1 and Q3) by KEK, correction coils provided by CERN, and absorbers to protect the magnets from secondary particles from the p-p collisions at the IP. These elements are assembled into three cryostats – Q1 plus correctors; Q2a, Q2b plus correctors; and Q3 plus correctors – by Fermilab.

The inner triplet quadrupole program includes:

- The design, construction and testing of a series of short (2 m) model magnets in order to develop the design features required to meet the functional requirements.
- The design, construction and testing of two full-scale prototype magnets a prototype cryostats. Testing of the first prototype is expected to be complete by the time of the review.
- The design, construction and testing of 18 quadrupole magnets, including spares, and the assembly of them and the KEK-provided quadrupoles, together with the CERN-provided correction coils, into complete magnets in cryostats ready for installation in the LHC.

The subject of this review is the production readiness of Fermilab to fabricate the inner triplet quadrupole cold mass. The production readiness for the cryostat, including the assembly of the several magnetic elements into complete helium vessels ready to insert into the cryostat, will be the subject of a separate review later this year.

Planned Design Reviews:

This Production Readiness Review (PRR) covers the MQXB inner triplet quadrupole cold mass. It follows a Conceptual Design Review (CDR) that was held in October 1996 and an Engineering Design Review that was held on 16 March 2000. The PRR of the inner triplet cryostat, including the procedures for assembling several magnetic elements into a complete liquid helium cold mass, will be conducted at a later date.

The PRR usually occurs after final proof-of-design is complete, i.e., after prototypes are delivered and tested successfully, etc. For the MQXB, testing of a full length prototype has recently been completed. Most materials have been ordered and received. The PRR is scheduled at this time to occur before the full production of the cold masses for the LHC begins.

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Production Team:

The production plan is represented by:

- Jim Kerby, FNAL Project Manager
- Fred Nobrega, FNAL
- Rodger Bossert, FNAL
- Mike Lamm, FNAL
- Jamie Blowers, FNAL

Design Review Committee:

The design review committee members are as follows:

- Phil Pfund, FNAL, Chair
- Jim Strait, FNAL
- Doug Fisher, FNAL
- John Cornuelle, SLAC
- Ranko Ostojic, CERN
- Akira Yamamoto, KEK

Scope of the Review:

The PRR will cover the plans for production of the hardware to be supplied. The PRR is expected to include a strategy for fabrication or procurement, quality assurance, testing, inspection, and engineering documentation. The plans to be reviewed and approved as part of the PRR are:

1. *Production Plan and Schedule*: This plan addresses the following plans that are to be reviewed at the PRR.
    - Procurement of components or subassemblies from outside vendors.
    - Fabrication at Fermilab of components or subassemblies.
    - Assembly of complete units at Fermilab.
    - Production and assembly schedule.
    - Fermilab staffing, equipment, and assembly areas to be utilized.
    - In-process and final testing of each component.

2. *Acceptance Plan*: This plan will describe the tests and verifications to be performed and the criteria for successful completion. This plan will eventually form an agreement between the US and CERN.

3. *Quality Assurance Plan*: The plan will be developed within the context of the Fermilab quality assurance program and procedures. It will be approved by the US LHC Accelerator Project Manager and receive concurrence from CERN.
4. *Engineering Documentation File*: The Equipment Safety MoU with CERN requires that a file for each design type be provided to the CERN mechanical safety group before production begins. The file will be amended with specific inspection and certification data for each device that is fabricated. In general terms, the standard contents of the Engineering Documentation File are itemized as follows:

    - Design specifications and calculations: mostly represented by Engineering Notes and Functional and Interface Specifications.
    - Material certifications and tests: this information will be made available with each completed magnet.
    - Transportation, installation, and operating procedures: this information will be made available with the completed magnet.
    - Equipment drawings: a list of drawings will be provided before the PRR. The complete drawing package is provided with the completed magnets.
    - Planned inspections and tests (mostly covered by the *Test Plan*)
    - Results of US Laboratory safety reviews: mostly related to lifting and handling of the heavy absorber components.

The review will not explicitly cover the cryostat. This will be covered by a separate review in the future.

The design review committee has the usual freedom to investigate other areas of the MQXB design and fabrication plans that present a risk to the successful completion of the project, installation, and operation in the LHC.

Date of the Review Committee Meeting:

The review is scheduled for Wednesday 20 June 2001 at Fermilab. It is anticipated to take one day.

Results of the Review:

This review and the following LQX cryostat review together comprise a Level-3 project milestone, scheduled for completion 15 July 2001. Each review will be complete with the issuing of a report summarizing the technical designs and plans reviewed, committee recommendations, and action items. The forecast date for completion of the MQXB cold mass review is 27 July 2001. The LQX cryostat review will be conducted later in 2001

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Schedule for the Review:

PRR Schedule – MQXB Cold Mass

4 Jun 01	Contents of Preview Package Selected
11 Jun 01	Contents of Preview Package Posted to PRR Web Site
18 Jun 01	Reviewer Preliminary Comments Returned to Chairman
19 Jun 01	Agenda Revised Based on Preliminary Comments from Reviewers
20 Jun 01	Production Readiness Review Meeting Conducted
28 Jun 01	Draft Report Sent to Reviewers
12 Jul 01	Reviewer Comments Returned to Chairman
27 Jul 01	Final Report of CDR Issued

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Agenda for the Review Meeting

PRR Agenda – MQXB Cold Mass
20 June 2001
Fermilab

9:15 am	Final Design – J. Kerby – 40 minutes • Progress since EDR • Status of specifications. • Results of prototype test program.
9:55 am	Materials and Parts – R. Bossert – 20 minutes • Status of detailed design drawings . • Summary bill of materials. • Status of parts on order or expected from CERN.
10:15 am	Quality Assurance – J. Blowers – 30 minutes • *Quality Assurance Plan*
10:45 am	Break – 15 minutes
11:00 am	Tour of Magnet Production Facilities – 30 minutes
11:30 am	Fabrication, Production Control – F. Nobrega – 45 minutes • Plant layout, tooling and equipment • Product flow • Travelers • Inspection & Records • Training & Qualifications
12:15 pm	Lunch – 60 minutes

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PRR Agenda – MQXB Cold Mass
20 June 2001
Fermilab

1:15 pm	Magnet Testing – Mike Lamm – 30 minutes • *Acceptance Plan* • Magnet Test Plan • Data exchange
1:45 pm	Schedule, Staffing, Wrap-up – J. Kerby –30 minutes • *Schedule* • *Staffing*
2:15 pm	Discussion
3:45 pm	Adjourn